

5

SECONDARY METHODS FOR NATURAL RESOURCE VALUATION: BENEFITS TRANSFER

5.1 INTRODUCTION

The goal of this chapter is to describe the "benefits transfer" method for assessing economic damages resulting from injury to natural resources. Benefits transfer involves the application of value estimates, functions, data, and/or models from existing studies to estimate natural resource damages for the case at hand. Benefits transfer is one of the methods designated for use in assessing compensable losses under DOI and NOAA's rules for damage assessment, and is referred to as the "unit value methodology" by DOI and the "benefits transfer approach" by NOAA [43 CFR 11.83 (c)(2)(vi) and 15 CFR 990.78 (c)]. This approach is considered a "secondary" valuation methodology, since it does not require primary data gathering or other primary economic research.

In natural resource damage assessment benefits transfer is often employed:

- When there is insufficient time or financial resources to gather primary data to support a full damage assessment;
- To generate preliminary, or "back-of-the-envelope," compensable loss estimates for purposes of damage assessment planning and budgeting;
- To generate preliminary compensable loss estimates for use in settlement negotiations; and
- When the expected magnitude of the damage claim does not justify the cost of primary economic research.

The existing literature provides a rich source of information on recreational user-day values, commercial fishing values, wetland values, passive use values, wildlife values and other values relevant to damage assessment. These value estimates have generally been developed using the

primary methods described in Chapter 4. This chapter is intended to provide a comprehensive discussion of benefits transfer, including guidance on the following topics:

- Definition of benefits transfer (Section 5.2)
- Steps for conducting benefits transfer (Section 5.3);
- Uses and types of benefits transfer (Section 5.4);
- Limitations of benefits transfer (Section 5.5); and
- Commonly referenced sources of valuation studies (Section 5.6).

Section 5.7 addresses a special case of benefits transfer -- the use of public and private expenditures and activities data as a means to infer resource values.

5.2 DEFINITION OF BENEFITS TRANSFER

Benefits transfer involves the application of value estimates, functions, data and/or models developed in one context to address a similar resource valuation question in an alternative context. Within damage assessment, benefits transfer in its simplest form involves the application of an existing estimate of the value of a natural resource (or a service provided by that resource) to estimate economic damages due to natural resource injury at the assessment site.¹ For example, an oil spill may have resulted in the temporary closure of a recreational fishery. Valuing economic damages associated with lost recreational fishing opportunities due to the spill event would first entail obtaining an estimate of the value of a recreational fishing day from the existing literature. This estimate would then be multiplied by the number of fishing days lost at the assessment site to generate an estimate of compensable value. Note that, in this example, primary research may be required at the assessment site to estimate the number of lost fishing days.

As described later in this chapter, such transfers may also include adjustments to account for differences in the characteristics of the service flow evaluated in the existing study versus the characteristics of the service flow at the assessment site. Continuing the oil spill example, the value per fishing day available from the literature may reflect the value for a day of fishing in general in the state in which the assessment is taking place. If, however, the injured resource represents a relatively high-quality trout fishery, it might be appropriate to adjust this value before estimating damages. Determining the appropriate adjustment factor would require additional review of the literature to evaluate the relationship between the value of a day of trout fishing versus other types of fishing. The trustee should consider whether such an adjustment is likely to have a significant enough effect on the magnitude of the estimated damages to warrant the time and effort required to estimate the adjustment factor.

¹ Throughout this chapter we refer to the site(s) or cases evaluated in existing study(s) as the "existing" site and the site affected by the release as the "assessment" site.

In addition, benefits transfer can involve the use of existing valuation functions or models. Such transfers allow trustees to develop value estimates using functions or models from existing studies that directly account for differences in the characteristics of the existing site versus the assessment site. For example, participants in a recreational activity considered in the existing study may have had higher income levels than participants at the site affected by the release. Such differences in income levels may affect the value per activity day held by the participants. If the existing study estimates the value per activity day as a function of income (and other variables), this defined relationship might be used to account for differences in the incomes of the households using or valuing the assessment site versus those represented in the existing study.

Although the technique of benefits transfer has been used for many years to assess natural resource damages, to support environmental policymaking, and to make resource management decisions, its use continues to generate some controversy in the economics community. This controversy focuses on the applicability of value estimates developed for a particular site, group of sites, or discharge incidents in one context to other sites or incidents in other contexts. In general, determining whether an existing study is appropriate for benefits transfer requires consideration of two factors: (1) the quality of the existing study (i.e., the defensibility of the research approach used), and (2) the similarity between the injured natural resource or lost service at the existing site and at the assessment site. Service personnel should consider the guidance provided in this chapter to help ensure the quality of the damage estimates generated by the benefits transfer approach.

5.3 STEPS FOR BENEFITS TRANSFER

Evaluating economic damages using benefits transfer consists of four steps:

- Step 1: Identifying the resource or services to be valued;
- Step 2: Identifying potentially relevant existing studies;
- Step 3: Evaluating the applicability of these existing studies; and
- Step 4: Conducting the benefits transfer.

Each of these steps is discussed in detail below.

5.3.1 IDENTIFY RESOURCES AND SERVICES

The first step in a benefits transfer is the identification of injured resources and/or lost services for which economic damages will be evaluated. In part this step will require identifying data that are or will be available to characterize the nature of the injury or service reduction (e.g., the number of lost use days or changes in the quality of the resource that would affect the values that the public holds for the resource). The types of data available and the nature of the service reduction will affect the types of transfers that can be applied. Second, trustees will determine whether to apply benefits transfer or one of the primary valuation methods described in Chapter 4 to evaluate economic

damages. Benefits transfer may be applied at various phases of the damage assessment process to: develop estimates of economic damages for use in negotiations with responsible parties; determine the expected magnitude of damages (for example, to identify those categories that may merit primary research); or document the likely magnitude of benefits that will result from a proposed restoration action.

5.3.2 IDENTIFY RELEVANT EXISTING STUDIES

The second step of benefits transfer involves review of the existing valuation literature to identify potentially applicable studies. This step entails identifying studies that evaluate similar resources and/or services as those affected at the assessment site. The types of studies to consider (e.g., contingent valuation, property valuation, travel cost) will depend on the types of injured resources and/or lost services. Note that if the transfer relies on the results from several studies, these studies need not apply the same valuation method.

Exhibit 5-1 summarizes the types of valuation approaches generally applied to various services and resource categories. Commonly referenced sources and bibliographies of studies that might be used for damage assessment are presented in Section 5.6.

5.3.3 EVALUATE APPLICABILITY OF EXISTING STUDIES

The third step in a benefits transfer involves careful review of the previously identified studies in order to determine whether the results are transferable to the assessment site. In addition, based on the types of information available from these studies (e.g., unit-day values, functions) and the nature of the injured resources or lost services, trustees can modify or refine the specific benefits transfer approach that they will utilize.

Evaluating the applicability of an existing study to the assessment site requires consideration of the nature of the services and resources addressed in the existing study and the services and resources affected at the assessment site. Without some degree of comparability between the existing site(s) and the assessment site, the transfer may not be reasonable or defensible. For example, transferring the value of a bald eagle to value mortality of a common bird species is not likely to be appropriate; however, a study that estimates the value of an additional nesting pair of bald eagles in Wisconsin may provide information for the valuation of the loss of a nesting pair of eagles in Michigan.

Three characteristics of a defensible benefits transfer are:

- The transfer relies on a high quality study(s) -- the results from the existing study should be based on adequate data, sound economic methods and correct empirical techniques;
- The characteristics of the resource/service evaluated in the existing study (including the availability of substitutes), and the characteristics of the

population that values the resource/service (e.g., age, income), are the same or similar to these characteristics at the assessment site;

- The transfer involves careful evaluation of the "extent of the market" in the existing study and the assessment site. Extent of market refers to the population likely to be affected by a change in the quality or quantity of the resource or service in question.

Exhibit 5-1	
SUMMARY OF VALUATION METHODS	
Resource or Service Category	Common Primary Valuation Approaches
RESOURCES	
Wetlands	Factor Income * Contingent Valuation
Surface Waters, Marine/ Aquatic Systems	Factor Income * Added or Averted Cost Contingent Valuation
Terrestrial Ecosystems	Factor Income * Contingent Valuation
Groundwater	Added or Averted Cost Appraisal Method Contingent Valuation
Wildlife Values (included fish, birds, mammals, etc.)	Travel Cost Methods Contingent Valuation
National Parks, Wildlife Refuges, etc.	Fee Losses Travel Cost Methods Contingent Valuation
SERVICES	
Recreation	Travel Cost Methods Contingent Valuation
Commercial Fisheries	Market Price Added or Averted Cost
Passive Use Values (e.g., existence values, nonuse values)	Contingent Valuation
* Various methods, including revealed preference techniques (e.g., travel cost methods, property valuation), added or averted cost, and contingent valuation can be used to value each of the services quantified through the factor income approach (e.g., the economic value of additional bird breeding habitat provided by wetland). For additional discussion, see Chapter 4.	

Exhibit 5-2 lists some of the factors that may be considered when assessing whether existing studies will support a defensible benefits transfer. Below we discuss each of the characteristics of a defensible benefits transfer.

5.3.3.1 QUALITY OF THE EXISTING STUDY

The defensibility of a benefits transfer will depend on the quality of the existing studies used to estimate economic damages. In general, the results of the existing studies should be based on sound economic methods and empirical techniques. For example, studies that rely on population samples should use state-of-the-art sampling methods, with sample sizes and response rates sufficient to generate and obtain statistically reliable results. Studies should take into account substitute goods and services.

While there are no standard criteria with which to judge the quality of existing studies for purposes of benefits transfer, the literature does provide some general guidance. Some good references include:

- For travel cost and random utility models used for valuing recreational opportunities: McConnell (1985), Smith (1990), Bockstael et al. (1987), Morey et al. (1991), Randall (1994).
- For contingent valuation studies used to value direct use and passive use attributes of natural resources: NOAA (1993) and (1994), Mitchell and Carson (1989).
- For repeat sale and hedonic property valuation studies used to determine the effect of environmental contamination on real property values: Bartik and Smith (1987), Freeman (1979), McConnell et al. (1985), Palmquist (1982), Polinsky and Rubinfeld (1977).
- For studies designed to determine the commercial fishing value of a resource: Riely and Rockland (1988).
- For studies of wetland values: Batie and Shabman (1982).
- For other types of valuation studies, and a general review of available valuation approaches: Desvousges and Skahen (1986), Krupnick (1991), McConnell (1993).

Exhibit 5-2

ISSUES TO CONSIDER IN CONDUCTING A BENEFITS TRANSFER

Similarity Between the Existing Site and the Assessment Site

- How does the affected resource compare with the resource referenced in the existing study?
- For what purpose were the original benefit estimates generated?
- What population group(s) was considered in generating the initial benefit estimates (e.g., a specific user group, such as recreational anglers, versus all residents of an area)?
- What was the nature of substitutes in the existing study area (e.g., alternative recreational opportunities), and how does this compare to the nature of substitutes at the release site?
- Does the existing study consider the same or a similar geographic area? Are the demographic and socio-economic characteristics of the two areas similar?
- If the existing study presents a composite of existing values based on an earlier literature review, what methods were used to derive these composite values and what was the nature of the underlying studies?
- If the benefit estimate being considered is for a generic resource category (e.g., song birds), are the species considered in the original study relevant to the case at hand?
- Were baseline conditions (e.g., ambient water quality) in the existing study similar to baseline conditions in the case at hand?
- Have general attitudes, perceptions, or level of knowledge changed in the period since the existing study was performed in a way that would influence the value of the benefit estimate? Are these values likely to be consistent over time?
- Were variables omitted from the original study that are believed to be relevant to the case at hand (e.g., the availability of substitutes)? To what extent does such omission prohibit the transfer?

Quality of the Existing Study

- Was the existing study published in a peer reviewed journal, or did it receive other forms of peer review?
- How is the existing study viewed in the professional community? How was the study viewed by its sponsor?
- If current "best research practices" were not used to generate the existing value estimate, can the estimate be adjusted to reflect changes in the state-of-the-art?

5.3.3.2 SIMILARITY OF RESOURCE/SERVICE CHARACTERISTICS AND POPULATION CHARACTERISTICS

Evaluating the applicability of an existing study to estimate economic damages at an assessment site involves comparing the characteristics of the injured resource or lost services in the existing study with the characteristics of the assessment site. If these characteristics differ, it will be necessary to consider whether these differences are likely to have a significant effect on the valuation of damages and if so, whether adjustments can be made to account for these differences.

Evaluating whether resource/service and population characteristics are similar enough to support a transfer between an existing study and a damage assessment largely depends on the judgement of the analyst, and the purpose to which the final estimate is to be put. Such an evaluation involves consideration of all characteristics of the resources and services that might affect the way an individual values them. As indicated by NOAA in its proposed rule [15 CFR 990.78 (c)(iii)], the change in the quality or quantity of the affected resource and/or services at the assessment site should be comparable to the quality and/or quantity addressed in the existing study. Other characteristics that may be relevant include, but are by no means limited to, the aesthetics of the site, the location of the site, the type of activity, and the distance of the site from population centers. To the extent that these characteristics affect individuals' values for the services provided by natural resources at a site, the characteristics should be similar across the existing study and the assessment site.

Trustees also should consider the extent to which substitutes for the resources and services provided by the site are available for the existing study and the assessment site and whether these substitutes have similar prices (e.g., for recreational opportunities, the distance that must be traveled to access the site). Differences in the availability and cost of substitutes are likely to affect the magnitude of economic damages. For example, if the site represents one of many local fishing sites that are of comparable quality, individuals may not suffer a complete loss of recreational opportunity if the site is closed to fishing because they can go elsewhere. Note that consideration of substitute sites also comes into play in estimating the number of lost use days since if an angler continues to fish at an alternate site, this does not represent a lost use day. Fishing at an alternate site may result in a loss of value (i.e., consumer surplus), however, if the angler has to travel farther to reach the substitute site, or if the quality of the substitute site is less than the injured site. The availability of substitute sites also is of concern in considering potential passive use losses resulting from the natural resource damage. For example, if the site provides the only known habitat for an endangered species, individuals may be more willing to pay to protect this habitat than if many sites in the region provide such habitat.

For the results of an existing study to be applicable to a damage assessment, the characteristics of the population affected by the release and those included in the existing study should be comparable. Relevant characteristics include, but are not limited to age, income, education level, proximity to the site and the level of environmental concern. Also, the population's familiarity with the natural resources at the site should be similar in the existing study and the assessment. For example, did the existing study involve residents of a community located near the natural resources being valued? Had an event recently occurred to make the individuals surveyed in the existing study more aware of or sensitive to environmental issues in a way which may have influenced the

magnitude of the value estimates? Prior experiences may influence perceptions, and thus affect the value that an individual holds for natural resources.

To compare population characteristics, means, medians and the range of values for these characteristics can be evaluated. Significant differences in population characteristics can be accommodated if the study case estimates resource or service values as a function of these characteristics. Small differences in population characteristics are unlikely to have a significant effect on economic damage estimates.

Finally it is relevant to consider the age of the existing study. Older studies are likely to be less applicable because the value society places on a given natural resource or service may change over time. For example, changes in information, real income, relative prices, or the availability of substitutes may influence the valuations of environmental commodities. Unfortunately, sufficient research has not been performed to indicate how long the results of a primary study remain valid for benefits transfer applications. Thus, analysts will need to apply their best judgement in evaluating this factor.

5.3.3.3 EXTENT OF THE MARKET

The "extent of market" for a natural resource is similar to the extent of market for any good or service purchased by consumers. For example, an amusement park might serve one county in the mid-west (i.e., most visitors to the park come from the county in which the park is located), or, as is the case of a large-scale theme park, consumers might be drawn from across the country. Similarly, each natural resource will have a geographic area over which its users are drawn.

An important component of economic damage estimation involves defining the extent of the geographic market for the affected natural resources and the services they provide. The extent of the market determines the size of the population that values the resource and services provided and thus has a significant effect on the magnitude of the resultant economic damage estimate. For example, the magnitude of passive use values associated with a resource can depend on the size of the population assumed to hold values for the affected resource (e.g., local, regional, national). For example, a study of the passive use value of a regionally important historic site might find that residents of the state in which the park is located would be willing to pay \$20 annually to preserve the park, on average, while the average resident of the U.S. may be willing to pay only five dollars. Note that the definition of the extent of market for a natural resource or service is a concern in applying all types of valuation methods, not just benefits transfer.

To estimate the extent of the market, analysts might consider the following factors:

- How unique is the resource? Are there other resources similar to it in the area? Is the resource locally important, regionally important, nationally important?
- How many households are likely to hold direct use or passive use values for the affected resources and what is the geographic extent of these households?

- How far do people travel to use the affected resources (prior to the release event)?

The definition of the market for the affected resources and services has implications for the transferability of values from the existing study to the assessment site. The size of the market considered in the existing study may have affected the magnitude of the value estimates generated. Thus, if the damage assessment does not involve a similarly defined market, transferring value estimates from the existing study to the assessment site may introduce a bias into the resulting economic damages estimate. For example:

- In valuing recreational activities, the distance of the individual's home from the site may affect the magnitude of the value held by the individual for the site. Thus, the size of the market considered will affect the reported average value for the site, and thus the transferability of the benefit estimate.
- The magnitude of passive use losses may depend on the proximity of the individuals surveyed to the assessment site. For example, individuals living close to a site may feel a greater stewardship responsibility for the site.

Unfortunately, the benefits transfer literature has not fully addressed the issue of how differences in the size and characteristics of the market affect the transferability of benefit estimates. When using benefits transfer techniques, analysts should carefully consider the extent of the market both in the assessment site and existing study and whether differences in these market definitions are likely to affect the value of the resources.

5.3.4 CONDUCT FULL BENEFITS TRANSFER

The fourth and final step in benefits transfer is to calculate economic losses. This involves application of the values, functions, data and or models identified in steps 2 and 3.

Analysts may want to consider a range of applicable value estimates, evaluating each based on the factors described above. Once a final set of values has been chosen, consideration should be given to their general magnitudes. If the existing value estimates differ significantly from one another, or if values generated using alternative value functions differ significantly from one another, consideration should be given to whether they differ in a predictable and consistent manner. If available values or models appear equally applicable, trustees may apply a range of values to the assessment, or use an average of these values.

5.4 USES AND TYPES OF BENEFITS TRANSFER

Two general concerns that may confront Service personnel applying the benefits transfer approach include:

- In what situations is it appropriate to apply benefits transfer? and,
- If benefits transfer is appropriate, what types of transfers can be applied?

This section addresses these two concerns.

5.4.1 WHEN TO USE BENEFITS TRANSFER

In natural resource damage assessment, benefits transfer is often used in situations requiring relatively inexpensive and fast approaches for estimating economic damages. Several factors that Service personnel should consider in deciding whether to use benefits transfer include:

- How does the expected magnitude of damages compare to the costs of assessing them?

DOI's and NOAA's rules require that natural resource trustees use cost-effective approaches for estimating economic damages. In some instances, the expected magnitude of the damage claim may not justify the cost of conducting primary research, and benefits transfer might be a more suitable approach.

- How much time and financial resources are available to assess the economic damages?

Since benefits transfer is relatively inexpensive and quick, this approach may be appropriate when resources are constrained.

- What is the purpose of the estimates?

Benefits transfer may be appropriate in instances when Service personnel need to evaluate the relative magnitude of the damages, or to decide which injury categories warrant further analysis. For example, benefits transfer is commonly employed in preliminary damage assessments.

- What is the level of uncertainty associated with the estimated effects on natural resources at the site?

Large uncertainties in the magnitude or scope of injured resources or lost services may influence the decision regarding the type of valuation

approaches to apply. That is, if estimates of the magnitude or scope of injured resources or lost services (e.g., the number of user-days lost) are highly uncertain, it may not be appropriate to spend significant time and resources assigning a precise dollar value to these effects.

Although benefits transfer is generally less expensive and time consuming than valuation methods involving original data collection and analysis, there are some instances in which relatively easy and inexpensive primary valuation approaches may be more suitable. For example, if a release results in the closure of a beach for which individuals paid an entrance fee, review of existing data on entrance fees collected before and after the release may serve as a means to estimate economic damages.² In fact, application of benefits transfer will generally involve some use of existing data combined with some original data collection. For example, assessment of damages resulting from the closure of a popular bird viewing area might entail an informal survey of area bird watchers to determine their response to the closure (e.g., visited another site, did not participate in bird viewing activities). Once the nature of the behavioral change is known, appropriate value estimates can be applied.

5.4.2 TYPES OF BENEFITS TRANSFERS

Benefits transfer is applicable to a wide range of valuation problems, and existing studies provide a wealth of information that can be applied in assessing economic damages. For example, benefits transfer might be used to assess reductions in:

- The number of recreational activity days at a site;
- The quality of a fishing experience at a site (e.g., a decrease in fish populations which reduces catch rates, or the imposition of a catch-and-release restriction to avoid public consumption of contaminated fish);
- The quality of a wildlife viewing experience at a site (e.g., reductions in bird populations leading to reductions in the number of birds, or the variety of species, seen by recreationalists);
- The quality of a hunting day due to reductions in bird populations (and thus, bag rates);
- The quality of a visitor day to a public park due to a release event at or near the park;
- Passive use values at a site;

² Note that these lost fees may not fully reflect damages if visitors were willing to pay more for entrance to the site than was charged (i.e., there were consumer surpluses associated with use of the site).

- Wetland values due to a release or site remediation activities (e.g., construction of a cap at a Superfund site); and
- Commercial fishing catch rates, or the closure of a commercial fishery.

Analysts can use any of several types of benefits transfer approaches to estimate economic damages, including simple transfers of resource values, transfers of valuation functions and models, or transfers of activity data. In the following subsections we describe the types of transfer approaches which are commonly used to assess economic damages in situations like those listed above.

5.4.2.1 VALUE TRANSFERS

Simple transfers of resource values involve the application of existing recreational activity values, species values, passive use values or other resource or service values (e.g., value per acre of wetland) to monetize changes in natural resource services provided by an assessment site. The transferred value can be a value reported in an individual study or the average from a set of studies that address the same or similar categories of resources or services.

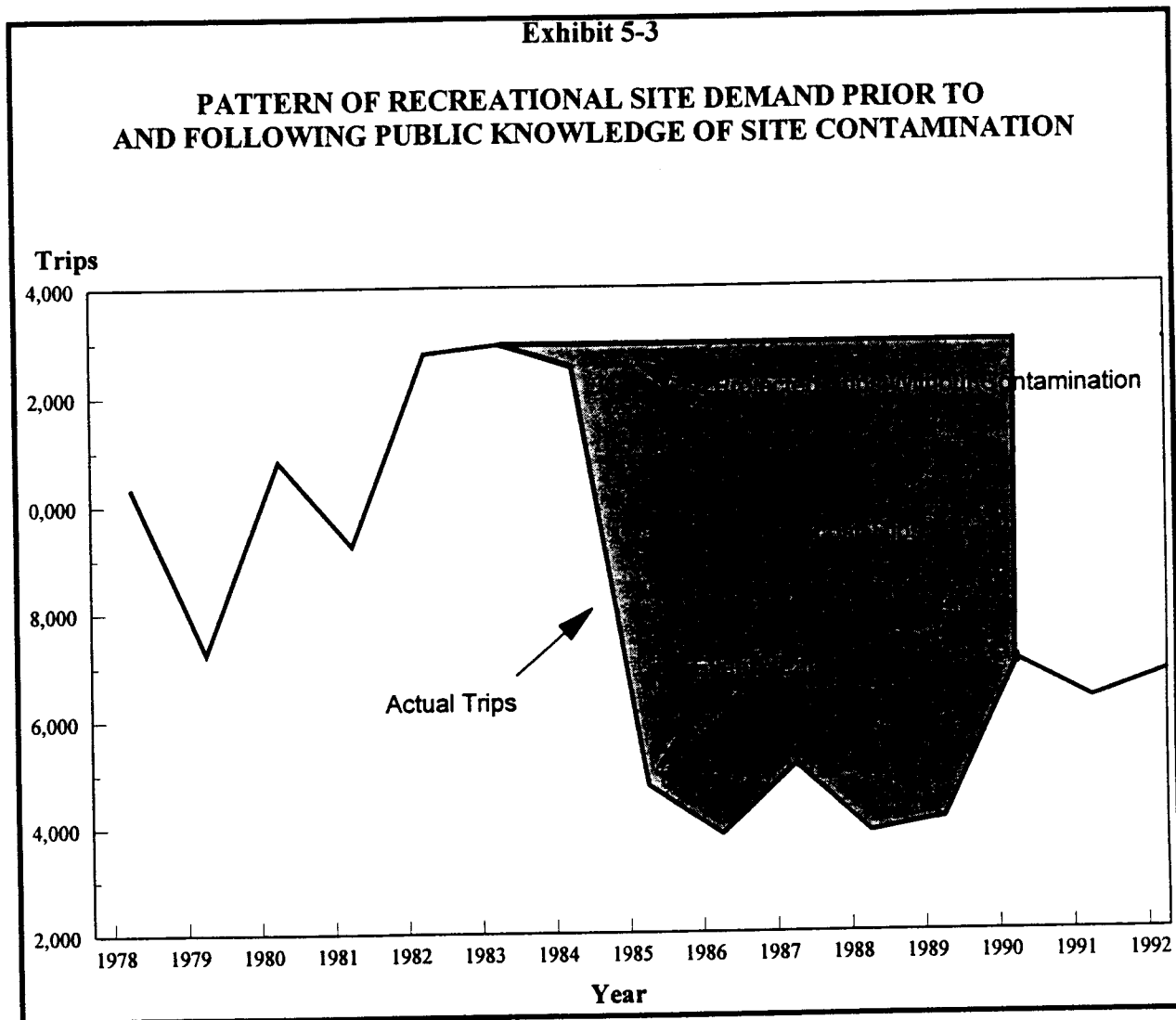
The first case study presented below ("Economic Damages Resulting from Diminished Recreational Services") illustrates this type of transfer. This case study describes an analysis of economic damages resulting from lost use of a recreational fishery due to PCB contamination. Economic damages from lost recreational fishing opportunities at this site are estimated based on the average value per fishing day from several existing studies that considered the value of a fishing day in the eastern U.S. These existing values are adjusted to reflect inflation. As discussed above, additional adjustments can be made to account for differences in site and population characteristics of the existing study and the assessment site, as warranted. In this case study, no such adjustments were made since the existing studies covered a broad range of site and population characteristics (and thus were viewed as broadly representative), and because this factor was not seen as a significant source of uncertainty in the final damage estimate.

A second type of value transfer involves the application of existing estimates of the passive use values of natural resources. In general, the transfer of existing passive use values can be used to generate order-of-magnitude economic damage estimates. These estimates can be used to determine whether it is appropriate to conduct primary contingent valuation research to obtain a more precise estimate. The second case study presented below ("Economic Damages Resulting from Injury to Endangered Species") illustrates this type of transfer. In this case, existing studies were used to develop an estimate of potential passive use losses at a creek that provides habitat to fish and wildlife, including several endangered and threatened species. These estimates were also used in preliminary negotiations with the responsible party.

Case Study: Economic Damages Resulting from Diminished Recreational Services

In this hypothetical case, the on-going release of PCBs from a Superfund site resulted in contamination of a creek and associated floodplain within a National Monument. This creek

represented a regionally important and popular native and stocked trout fishery prior to the release event. As a result of the discovery of PCBs at the site, a catch-and-release restriction was instituted on the creek and health advisories were posted. In addition, the state Fish and Game Commission and several private organizations halted stocking activities at the creek. As a result of these events, which occurred in late 1984 and early 1985, there was a sharp reduction in public use of the creek as a recreational fishery (see Exhibit 5-3).



Given the need to generate a damage claim within the time frame of remedial action selection, a site-specific travel cost analysis was not possible. Thus, the trustees undertook a benefits transfer exercise to document the magnitude of damages to the resource. This analysis was made-up of two parts: (1) determination of the magnitude of the reduction in visitation to the creek; and (2) a review of the economics literature to estimate the value of a lost recreational fishing trip in the area of the release.

In order to determine the magnitude of reduced visitation to this site, the trustees reviewed fishing pressure data kept by the National Monument. These data were based on angler and car counts taken on a regular basis from the road by park employees. This historic record indicated that fishing pressure at the site was increasing prior to public knowledge of the contamination. For purposes of the assessment, however, the trustees made the conservative assumption that the total number of trips to the creek from 1985 to 1990 in the absence of the release event would have remained constant at the level experienced in 1983, the last year in which demand for the site was not affected by a health advisory. In 1990 the state had reclassified the creek as a "Class A" fishery. Creeks in this class are not stocked, since they are assumed to be capable of supporting self-sustaining wild trout populations. Since much of the demand for the creek prior to public knowledge of the contamination was associated with these stocking events, the trustees assumed that demand would have declined after 1990, since anglers would not have had the opportunity to catch stocked trout in the creek regardless of the level of PCB contamination. The trustees incorporated this factor into the analysis by assuming that no loss in recreational fishing opportunity had occurred as a result of PCB contamination after 1990. Based on this analysis, the trustees established the total number of trips lost due to PCB contamination from 1985 to 1990.

Given an understanding of the magnitude of lost recreational services, the trustees undertook a review of the recreational valuation literature to establish the economic value of these lost trips. The results of this review are presented in Exhibit 5-4. Recreational losses can generally be divided

Exhibit 5-4							
USE VALUES PER FISHING DAY							
Study Authors/ Publication Date	Model Type ¹	Source of Data	Scope of Study	Fishing Type	Year	Value (Reported)	Value (1992 \$) ²
Brown and Hay (1987)	CVM	1980 National Survey ³	U.S.	Trout	1980	\$12.00	\$20.23
Brown and Hay (1987)	CVM	1980 National Survey	Pennsylvania	Trout	1980	\$8.00	\$13.49
Miller and Hay (1984)	TCM	1980 National Survey	Maine	Fresh water	1980	\$23.00	\$38.78
Miller and Hay (1984)	TCM	1980 National Survey	Tennessee	Fresh water	1980	\$30.00	\$50.59
Miller and Hay (1984)	TCM	1980 National Survey	Minnesota	Fresh water	1980	\$29.00	\$48.90
Vaughn and Russell (1982)	TCM	Private Fee Fishing Sites	U.S.	Trout	1979	\$19.49	\$35.97
Connelly, Brown, and Knuth (1990)	CVM	N.Y. State Angler Survey	New York	Cold water	1988	\$13.42	\$15.62
						Average	\$31.94
1 CVM is Contingent Valuation Method; TCM is Travel Cost Method.							
2 Economic values per fishing day are converted to 1992 dollars using the gross domestic product (GDP) implicit price deflator (BEA 1992).							
3 1980 National Survey of Fishing, Hunting and Wildlife-Associated Recreation conducted by the U.S. Department of the Interior.							

into three categories: (1) losses associated with trips foregone; (2) losses associated with trips taken to substitute sites that may be of lower quality or require additional travel; and (3) losses associated with trips still taken to the affected site, but which are of a diminished quality. In this case the trustees determined that those trips not taken to this site (as demonstrated by reduced demand for the site starting in 1984) represented trips foregone, not trips simply substituted to other sites. The principal supporting arguments for this assumption were the overall high quality of the fishing experience, as well as ease of public access afforded by this site, and the fact that the state agency and private organizations who had stocked the creek prior to discovery of PCBs did not switch these stocking operations to other sites (i.e., the fishing opportunity associated with these stocked fish was lost). The trustees did not consider economic losses associated with a reduction in the value of those trips that were taken to the site despite the catch-and-release restriction and health warnings.

As shown in Exhibit 5-4, the trustees identified seven estimates that were relevant to this case. These included fishing day value estimates based on travel cost studies and two contingent valuation studies. These estimates were selected following the benefits transfer protocol described earlier in this chapter. The review indicated that a lost recreational fishing day in this region would be expected to generate an economic loss of about \$32 (1992 \$).

The final damage calculation is summarized in Exhibit 5-5. The second and third columns of this exhibit summarize the estimated number of lost fishing trips to this site and the economic damage associated with these lost trips. In the third column the trustees net out the annual cost of stocking the creek. Since stocking operations were halted in response to the contamination event, and were not simply moved to another site, the trustees avoided these costs. The net economic damage estimate is presented in the final column of this exhibit.

Exhibit 5-5				
ESTIMATED ECONOMIC DAMAGES FROM LOST USE DUE TO PCB CONTAMINATION				
Year	Estimated Number of Lost Fishing Trips	Estimated Economic Damages (1992 dollars)	Avoided Cost of Stocking ¹ (1992 dollars)	Present Value of Economic Damages (1992 dollars) ²
1985	8,196	\$262,272	\$6,768	\$410,284
1986	9,118	\$291,776	\$6,768	\$427,720
1987	7,827	\$250,464	\$6,768	\$341,796
1988	9,083	\$290,656	\$6,768	\$372,119
1989	8,827	\$282,464	\$6,768	\$337,739
1990	5,905	\$188,960	\$6,768	\$208,592
Total				\$2,098,250
¹ Avoided stocking costs are estimated based on the number of acres (23.5) multiplied by the stocking rate (400 fish per acre) multiplied by the cost per stocked fish (\$0.72 per fish).				
² Yearly totals are discounted using a seven-percent interest rate.				

This analysis indicated that interim lost use (i.e., compensable) values at this site were at least two million dollars. The trustees used this analysis to argue for a more comprehensive remedy at the Superfund site to address off-site environmental and human health risks.

Case Study: Economic Damage Resulting from Injury to Endangered Species

In this hypothetical case, an oil pipeline break results in the release of a petroleum product to a mid-western stream. The stream is a known habitat for several federally listed endangered species, and has been recognized by a national conservation organization as an important regional ecosystem. The federally listed species affected by the spill are freshwater fish and shellfish, not "charismatic megafauna." The site supports little on-site recreation or other direct use. A preliminary field assessment indicates that the spill may have resulted in the extirpation of several species of endangered shellfish from the creek (due to mortality resulting from direct contact with the oil), and likely eliminated fish from a segment of the creek.

In order to establish a preliminary estimate of damages for use in negotiations with the responsible party, and to assess the possible application of the contingent valuation technique to establish a compensable damage claim in this case, the trustees undertook a review of the economics literature to better understand the types of values that would be generated by a high-quality contingent valuation survey. This literature review followed the protocol for benefits transfer described in this chapter. Exhibit 5-6 summarizes the results of this review.

Five studies were identified that addressed resources similar to those of relevance to this case. These included studies of:

- Ohio residents' willingness-to-pay to finance resource management projects to maintain biodiversity, improve stream bed visibility (i.e., improve water clarity), and improve hiking trails at Big Darby Creek.
- The willingness of individuals with Montana fishing licenses (both in state and out-of-state) to pay to lease water rights, as needed, to increase instream flows in two Montana streams that are spawning habitat for several species of concern (the arctic grayling and cutthroat trout).
- Illinois households' willingness-to-pay to protect the quality of the state nature preserve at Illinois Beach State Park.
- Kentucky households' willingness-to-pay to preserve wetlands rather than permit development for coal mining.
- Wisconsin residents' willingness-to-pay to preserve the bald eagle and a less well known threatened species, the striped shiner.

Exhibit 5-6

ESTIMATED VALUES OF RESOURCES SIMILAR TO AFFECTED STREAM

Authors (Date)	Site Location	Description of Commodity	Annual Willingness to Pay (WTP) per Household	
			Reported Year \$	1993 \$ ⁴
Wu (1991) ¹	Big Darby Creek, OH	WTP to finance resource management projects to maintain biodiversity, improve stream bed visibility, and improve hiking trails at Big Darby Creek.	Ohio Public: \$8.84 - \$11.78 Adj. Ohio Public: \$2.54 - \$3.46 (1990\$)	Ohio Public: \$9.69 - \$12.91 Adj. Ohio Public: \$2.78 - \$3.79
Duffield and Patterson (1991) ²	Swamp Creek and Big Creek, Montana	WTP to lease water as needed to increase instream flows in two creeks that are spawning tributaries for two Montana species of concern.	Unadjusted: \$8.44 - \$12.26 Adjusted: \$0.93 to \$6.15 (1990\$)	Unadjusted: \$9.25 - \$13.44 Adjusted: \$1.02 - \$6.74
Boyle and Bishop (1985) ³	Illinois Beach State Park, including Nature Preserve, IL	WTP to preserve the state nature preserve at Illinois Beach State Park, including construction of a breakwater and day-to-day park management.	\$16.44 (1985\$)	\$21.63
Whitehead and Blomquist (1991)	Clear Creek, KY	WTP to preserve the Clear Creek wetlands rather than permit development of wetlands for coal mining.	\$7.00 - \$10.00 (1989\$)	\$8.01 - \$11.45
Boyle and Bishop (1987)	Wisconsin	WTP to preserve the bald eagle and the striped shiner.	Contributors to state wildlife program: Mean: \$5.66 Median: \$1.00 Non-Contributors: Mean: \$4.16 Median: \$1.00 (1985\$)	Contributors to state wildlife program: Mean: \$7.45 Median: \$1.32 Non-Contributors: Mean: \$5.47 Median: \$1.32

1. The values reported here are for the sample of Ohio households. The adjusted values assume that non-respondents have a zero value. The range of values reflect different models used to estimate WTP from the survey data.
2. These values are for the entire sample, including resident and non-resident households with Montana fishing licenses. The adjusted values assume non-respondents have a zero value. The range of values reflects the variation across the different versions of the survey (i.e., actual payments to the Montana Nature Conservancy, hypothetical payments to the Montana Nature Conservancy, and hypothetical payments to an unspecified foundation). Respondents may have considered their bids as one-time payments since the survey did not indicate otherwise.
3. The value reported here is the median WTP of households that have not used the nature preserve.
4. Values are adjusted to 1993 dollars using the GDP implicit price deflator, taken from The Economic Report of the President, February 1994. The deflator for 1993 is a preliminary estimate.

It was important for the trustees to note that none of these studies met all of the guidelines for contingent valuation research for purposes of damage assessment, as described by the NOAA Blue Ribbon Panel or as proposed by NOAA in its rule for damage assessment under the OPA. Based on this review, the trustees determined that, if they were to conduct a state-of-the-art contingent valuation study of this incident, they would likely find the public's stated willingness-to-pay to preserve the injured stream to be *at least* \$2.50 to \$5.00 per household. Based on additional consideration of the contingent valuation literature, this value was assumed to apply to all households in the two states traversed by the affected stream. The result of this effort indicated that damages associated with the spill were at least \$15 to \$30 million. This value range was used for damage assessment planning purposes by the trustees, and was used in settlement negotiations with the responsible party.

5.4.2.2 TRANSFERS OF VALUE FUNCTIONS AND MODELS

Transfers of value functions and models generally take on one of two forms in damage assessment cases. In one form, estimates of economic damages are developed by transferring available estimates of resource values expressed as a function of the site's characteristics and/or the characteristics of the affected population. For example, it may be possible to estimate a recreational user day value for an assessment site by transferring a value function from an existing study, and applying in that function median or average values for the physical and demographic characteristics of the assessment site. The following case study illustrates this type of transfer.

Case Example: Transferring a Valuation Function for Groundwater Valuation

This example considers the economic damages resulting in a hypothetical case in which the release of a toxic substance has contaminated a groundwater aquifer. This release has resulted in lost use and passive use values. In this case the trustees chose to evaluate lost use values using the averted behavior method described in Chapter 4. In addition, in order to evaluate total losses (including passive use losses), the trustees chose to apply the groundwater valuation function available from an existing contingent valuation study (McClelland et al. 1992). This study expresses groundwater value as a function of several variables, including the region of the country in which the aquifer is located, and average income levels in the local area.

The value function estimated in McClelland et al. is based on household responses to a contingent valuation survey. The question asked how much were households were willing to pay, in the form of increased water bills, for remediation of a defined groundwater contamination problem.³ The resulting function is:

³ See McClelland et al. (1992) for a complete review of the injury description used in this study.

$$Value = 3.0685 + (0.0665 * Income) + (0.7878 * Northwest)$$

where,

Value = annual use and nonuse value per household for groundwater;
Income = average annual income per household (thousands of dollars); and,
Northwest = 1 if the household is located in the northwest and 0 otherwise.

Note that McClelland provides coefficients similar to the "northwest" coefficient reported above for other regions of the U.S.

Assuming that the site is located in the northwestern U.S. and the average annual household income level in the counties surrounding the site is \$35,000, then plugging these values into the above function yields an estimate of \$6.18 per household. That is, the loss of this aquifer as a groundwater resource as a result of a contamination event has likely resulted in economic damages of about six dollars per household for each year in which the aquifer remains contaminated. The wording of the question in the McClelland survey implies that this estimate includes both direct use and passive use losses.

This example is provided as an illustration of the application of a value function to estimate compensable damages. To use this particular study and approach for valuing lost services resulting from contamination of groundwater due to a toxic release or oil spill, Service personnel would need to consider whether the valuation question in this existing contingent valuation study is applicable to their assessment site. In addition, this study has been subject to the general controversy surrounding the contingent valuation method, as well as some more study specific criticisms (e.g., an EPA Science Advisory Board has criticized the wording of questions used in the McClelland survey instrument). Thus, application of damage estimates based on this and other existing contingent valuation studies may be limited to preliminary assessments and use in settlement negotiations with responsible parties.

* * * * *

A second application of benefit function transfer involves the use of observed relationships between the value of a natural resource and/or service and the characteristics of the site. For example, the release of oil or other hazardous materials to the environment can affect recreational activities in three ways:

- Users may forego the activity entirely, given closure or degradation of the site;
- Users may go to substitute sites (thus incurring additional travel costs or reductions in the quality of the experience); and/or
- Users may continue to use the site, despite the decline in quality.

Since the value of a fishing day may in part depend on the number of fish caught, a reduction in catch rates at a site due to a contaminant release event may result in any or all of these behavioral

responses. In this case trustees could consider studies that examine the relationship between catch rate and the value per activity day and studies of the value of a lost fishing day in order to evaluate the economic damages resulting from this type of resource injury.⁴

Similarly, the value of a bird viewing day may depend on the number of birds seen at a site. Cooper and Loomis (1991) report that respondents to a contingent valuation survey were willing to pay to increase the number of birds seen on their most recent bird viewing trip. This research suggests that reductions in bird populations at a site can have a negative effect on the value of bird viewing trip. The relationship observed by Cooper and Loomis could be used to evaluate the change in the value of bird viewing days resulting from oil or other hazardous material releases. An example of this type of transfer appears in the case study presented below ("Economic Damage Resulting from Injury to Migratory Waterfowl"). Note that the proposed Type A model for the Great Lakes Environment uses the results of the Cooper and Loomis study and this type of benefits transfer approach to evaluate economic damages associated with non-consumptive wildlife-associated recreation.

Value function transfers have also been used to estimate economic damages resulting from injury to birds and the resulting effects on waterfowl hunting. For example, results of a study by Charbonneau and Hay (1978) evaluate the effect of increases in waterfowl populations on the value of a hunting day. The Type A model uses this approach in estimating damages associated with lost hunting services provided by waterfowl populations.

Case Study: Economic Damage Resulting from Injury to Migratory Waterfowl

This case draws on the restoration program costing example provided in Chapter 3. In this case an oil spill off the coast of Northern California resulted in the abandonment of a seabird colony. Based on a series of injury studies, the trustees concluded that this event significantly increased the probability that the entire southern range of this species could be lost, natural recovery and repopulation of the colony was unlikely, and even if recovery did occur, the public would experience direct use (i.e., diminished bird viewing opportunities) and passive use losses from the time of the spill until full recovery was achieved. However, for a variety of reasons, no compensable damage claim was developed by the trustees.

Since the trustees did not believe that natural recovery was likely, they proposed an aggressive bird recolonization project. This proposed project involved use of decoys and audio cues to encourage breeding birds to return to the affected site. Given the technical nature of this project, several experts would be involved, as well as associated support staff. The abandoned colony was located in a remote location; thus, the trustees needed to account for travel costs and other costs associated with site access. The trustees planned to contract the restoration effort out to a private organization. It was expected that the project would require 10 years to complete, at a total cost of \$4.5 million.

⁴ Studies that address this issue include Samples and Bishop (1985), Brown and Plummer (1989), Vaughan and Russell (1982), Milon (1989), and Bockstael, McConnell and Strand (1989).

The responsible party contested this claim based on several arguments, including that the cost of the proposed restoration action was "grossly disproportionate" to the value of the lost resource. Three separate analyses were conducted by the trustees to document the likely benefits of their proposed restoration option. These included:

- A benefits transfer exercise, drawing passive use and total values from the literature for similar resources;
- A benefits transfer-based review of the recreational valuation literature, with a focus on studies that provide estimates of the marginal value of additional bird viewing opportunities; and
- An inventory of public uses of this resource, including commercial charter and private boat trips taken to the site prior to the spill.

The trustees first undertook a review of the contingent valuation literature to identify studies that provided passive use values (or total values incorporating both direct use and passive use) for non-game wildlife species. The trustees focused this review on studies that addressed the economic value of bird species and also satisfied the benefits transfer criteria described in this chapter. The results of this literature review are presented in Exhibit 5-7. The trustees did not use these results to generate an estimate of the total economic loss associated with this spill event, but instead used them to demonstrate that such resources have value, and that a state-of-the-art contingent valuation study of this event would likely demonstrate a significant willingness-to-pay by the public to undertake the selected restoration option.

The trustees also undertook a benefits transfer exercise, following the protocols described in this chapter, of recreational use value studies that consider the economic value of bird viewing opportunities. The first study (Hay 1988) used contingent valuation data from the U.S. Fish and Wildlife Service's 1985 National Survey of Fishing, Hunting and Wildlife Associated Recreation.⁵ Hay uses responses to this survey from individuals who travelled at least one mile from their home for the primary purpose of observing or photographing wildlife, and reports a \$32 per trip value for California (1985\$).

The trustees considered a second study (Cooper and Loomis 1991) that uses the contingent valuation method to define a value per day of bird viewing activity in California, and a value per each additional bird seen during these trips. This study found the value for a day of bird viewing in California to be \$37.33 (1987 \$), which was determined to be reasonably close to the value reported by Hay, especially when Hay's value is inflated to 1987 dollars. In addition to providing an estimate of the value of a day of bird viewing, the Cooper and Loomis study was also used to estimate the

⁵ Results from the 1991 version of this survey are now available.

Exhibit 5-7		
A REVIEW OF PASSIVE USE AND TOTAL VALUES FOR NONGAME BIRD SPECIES BASED ON CONTINGENT VALUATION STUDIES *		
Study	Description of Environmental Good Being Valued	Results (\$ household)
Bowker and Stoll (1988)	Willingness-to-pay into a fund to maintain the Aransas National Wildlife Refuge for the Whooping Crane, in order to prevent extinction of the Whooping Crane. Residents of Texas, as well as residents of Los Angeles, Chicago, Atlanta and New York were surveyed.	\$22 (1983 \$)
Boyle and Bishop (1987)	Willingness-to-pay to preserve the bald eagle in Wisconsin. Donors and non-donors and a State of Wisconsin Endangered Resources Donation program were surveyed.	\$5 (1984 \$) (for non-donors)
Hoehn and Loomis (1993)	Willingness-to-pay to reduce agricultural contamination in the San Joaquin Valley, which results in reproductive failure in egrets, black necked swifts, herons and other waterfowl. California residents were surveyed.	\$27 (1989 \$)
Stevens et al. (1991)	Willingness to enhance New England populations of bald eagles and wild turkey.	\$28 (1989 \$) for bald eagle \$7 (1989 \$) for wild turkey
Hagen et al. (1992)	U.S. households' willingness-to-pay for a conservation plan to protect the Northern Spotted Owl in the Pacific Northwest.	\$86 (1990 \$)
Rubin et al. (1991)	Washington State residents' willingness-to-pay to preserve the Northern Spotted Owl.	\$22 (1987 \$) (For a 50 percent probability of owl survival.)
Rowe et al. (1992)	Washington State residents' willingness-to-pay to avoid the loss of 40,000 seabirds as a result of an oil spill off the Washington State Coast.	\$19 (1989 \$)
Loomis (1987)	California households' willingness-to-pay to protect Mono Lake, California as a habitat for a variety of bird species.	\$89 (1986 \$)
* The values presented in this exhibit are approximate and are presented only for illustrative purposes. They may not be appropriate for actual cases.		

value of an increase in the number of birds seen. Specifically, the results of this study imply a willingness to pay of \$0.54 per additional bird seen.

These results were used by the trustees to demonstrate that a reduction in bird viewing opportunities due to this oil spill most likely did result in a reduction in economic surplus provided by this resource. At a minimum, the 5,000 individuals who participated in charter boat trips which had included a visit to the affected site prior to the spill experienced such losses. In addition, individuals who viewed birds from the affected colony from other viewing locations (such as coastal vistas) would also have experienced some loss in surplus. The existing data were not sufficient to

calculate economic damages associated with lost viewing opportunities (e.g., the actual decline in the number of birds seen by bird viewers was unknown). However, this exercise provided evidence that such losses likely occurred, and that efforts to restore the lost colony would result in real economic gains associated with use of this resource.

Finally, the trustees undertook a telephone survey of charter boat operators and private bird viewing clubs and other organizations to gather information on (1) the number of boat trips taken to the injured colony prior to the spill event; (2) the nature of these trips (i.e., whether the trips involved bird viewing as the primary activity, whether the site in question was a feature of the trip, etc.); (3) the number of individuals participating on these trips; and (4) where these individuals were from (i.e., were they primarily local bird viewers, individuals from the rest of the U.S., or individuals from around the world). In addition, the trustees inquired as to whether the trips previously taken to this site were canceled after the spill, or if they were taken to substitute locations.

Based on this survey of site use, the trustees determined that approximately 5,000 individuals per-year had visited this site prior to the spill, primarily through two commercial charter operations out of a nearby harbor. These visits were generally taken as part of a longer boat trip, with attractions including whale watching and bird viewing at other locations; however, this colony, due to ease of access, was considered a popular stop on the tour. The average charge for these trips, in 1994, was \$30. The majority of the participants were from California, but nearly all of the trips included individuals from other parts of the U.S. and other areas of the world. The charter boat operators had continued to run trips following the spill, but had not substituted alternative sites for the injured colony since travel times to possible substitute sites were too long. Based on this information, the trustees concluded that a real reduction in use value associated with the spill had occurred, and that if a formal survey of charter boat patrons were undertaken, these individuals would express a willingness-to-pay to restore the site. Thus, while this review did not produce an estimate of the dollar value of this site as a recreational resource, it did provide evidence that the site was used prior to the spill, and that a real loss had occurred as a result of the loss of abandonment of the colony.

These analyses were used in negotiations with the responsible party, and in preparing for deposition of the economic experts hired by the responsible party in this case.

5.4.3 TRANSFERS OF ACTIVITY DATA

Transfers of data, functions or models from existing studies can be used to estimate the number of lost recreation days at an affected site. For example, Brown and Hammack (1978) provide data on the relationship between the number of birds at a National Wildlife Refuge in Maryland, and the number of visitor days to the Refuge. This relationship could be used in estimating the magnitude of the decline in bird viewing days at a site resulting from injury to bird populations. Other examples of the transfer of activity data include:

- **Bird Viewing Activity Data.** Although site-specific data on bird viewing activities are not available for most sites, the U.S. Fish and Wildlife Service and some state agencies collect state-level data on non-consumptive wildlife-associated recreation,

including bird viewing activities. These data could be used in developing estimates of the level of bird viewing activities at a site.

- **Recreational Fishing Activity Data.** As with bird viewing, site specific data on fishing levels might not be available for each assessment site, but may be available for sites with similar characteristics or at a state-wide level. Such "fishing pressure" data (generally expressed in terms of number of participants per day per mile of river or acre of surface water body) may be transferred by considering the length of the affected stream or size of the affected water body, and such factors as the availability of site access and the baseline water quality of the affected stream relative to those sites for which fishing pressure data are available.

5.5 LIMITATIONS OF BENEFITS TRANSFER

The limitations of the benefits transfer method principally relate to potential uncertainties (or bias) in the resulting damage estimates due to potential differences in the characteristics of the existing study and those of the assessment site, and the quality of available studies. The quality of the resultant estimate will depend on the quality and number of existing studies, and the level of effort and care taken by the trustees in performing the transfer. No benefits transfer will be perfect; however, the extent to which the criteria defined above are considered will determine the quality of the resultant estimate. In all cases trustees should attempt to be conservative (i.e., select assumptions and values that are more likely to understate damages than to overstate damages). In addition, trustees should consider the purpose for which the damage estimate is being generated. For example, a preliminary estimate that is developed to support the damage assessment planning process may not need to be as precise as one developed for settlement negotiation purposes.

Note that the limitations associated with the benefits transfer method are acute when the transfer involves passive use values. This is the case because (1) passive use values are viewed as being highly site-specific, and thus the transfer from one site to another may be controversial, and (2) few existing contingent valuation studies that evaluate passive use values meet the current criteria for a high-quality contingent valuation study. Thus, in most cases, passive use value estimates developed for an injured resource will be applicable for purposes of preliminary damage assessment or settlement negotiations with the responsible party, and not for purposes of the presentation of a damage claim in court.

5.6 COMMONLY REFERENCED SOURCES FOR USE IN BENEFITS TRANSFER

There are a number of bibliographies and databases that can be used to identify potentially applicable existing studies. These include:

- The Environmental Benefits Database compiled by NOAA, EPA and others, and maintained by EPA's Office of Policy, Planning and Evaluation.⁶
- Various reviews of the existing contingent valuation literature (these studies include assessments of a wide-range of resource categories and services): Carson et al. (1994); Mitchell and Carson (1989) and Cummings et al. (1986).
- Several surveys of the recreation literature: Walsh et al (1989, 1992); Bockstael et al. (1986), Loomis and Sorg (1983).
- The fish kill valuation guidelines provided by the American Fisheries Society (1990).
- Surveys of the wildlife valuation literature, including (Iec 1991) and various state guidelines for restitution (e.g., State of Minnesota (1991), Talhelm (1990)).
- Surveys of the groundwater valuation literature, including Boyle (1994).
- Studies of the economic value of wetlands: Anderson and Rockel (1991), Scodari (1990), Douglas (1989) and King (1990).
- Studies of the economic value of marine resources, including Freeman (1993).

Benefits transfer has recently received increased attention in the economics literature. For further discussion of benefits transfer, see: Atkinson et al. (1992); Boyle and Bergstrom (1992); Brookshire and Neill (1992); Desvousges et al. (1992); Loomis (1991 and 1992); Luken et al. (1992); McConnell (1992); Smith (1992); Smith and Kaoru (1990); and Walsh et al. (1989).

5.7 USE OF PUBLIC AND PRIVATE EXPENDITURES AND ACTIVITY DATA

Public policies protecting natural resources and public and private expenditures on endangered species and their habitats demonstrate that the public values these resources. For example, in passing the Endangered Species Act, Congress found that endangered and threatened species "are of aesthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people" [Section 2, 16 USC 1531]. Public and private expenditures reveal that the public is willing to make financial sacrifices to preserve important natural resources. For example, recent actions have been taken to preserve old-growth forests and the northern spotted owl, despite the fact that these actions will reduce revenues from timber sales and result in job loss in the logging industry.

Public and private expenditures to protect a natural resource, however, do not provide a measure of absolute value of a resource (Freeman 1993). There are several reasons why these

⁶ Computer disk copies of this database can be obtained by contacting the U.S. Fish and Wildlife Service's Division of Economics.

expenditures do not provide an accurate value measure. First, public expenditures are affected by the political process and efforts by special interest groups to influence programs and policy (Coursey 1994). Second, state and federal government agencies have limited resources available to finance competing programs. Finally, and most importantly, direct expenditures do not reflect the opportunity costs of development (or other economic activity) foregone, which in many cases can be quite large.

Donations to and expenditures by private organizations also do not measure the full value of preserving natural resources (Freeman 1993). First, private donations suffer from the "free rider" problem, which causes donations to understate the value of a resource.⁷ Second, private expenditures are complicated by the political process; that is, private organizations often spend money to advocate positions or influence policy. The magnitude of these expenditures may not depend on the value of the resource. Rather, a rational organization with limited resources would seek to maximize the benefits of its expenditures on its activities. Thus, expenditures for a particular activity will depend on the marginal productivity of a dollar spent across all activities. Finally, because organizations typically support a number of activities, it may be difficult to attribute contributions to a particular activity.

Despite these limitations, in some cases it may be useful for trustees to review information on public and private expenditures to preserve or enhance natural resources, as one indication of the value of these resources. This is a special case of benefits transfer, where the existing value is current public or private expenditures on the resource (or a similar resource) in question. For example, trustees might consider expenditures by federal and state governments to protect endangered and threatened species and their habitat under the Endangered Species Act, as well as specific expenditures by federal and state governments and private organizations to preserve the resource in question (or a similar resource) and/or to protect species that rely on that resource.

⁷ The free rider problem refers to the fact that individuals have incentives to understate their willingness to pay for public goods, since they cannot be excluded from enjoying the benefits of public goods, and they therefore can get a "free ride" on the contributions of others.